Section 922. TEMPORARY TRAFFIC CONTROL MATERIALS

922.01 Description. All temporary traffic control devices shall meet the design requirements of the MMUTCD, Part VI, in addition to materials requirements specified in this section.

The Contractor shall furnish the Engineer with certification that the materials and devices conform to these specifications. Certification furnished by the Contractor does not waive inspection, sampling, or testing of materials and devices, as determined by the Engineer.

922.02 Temporary Signs.

A. **Sign Panel and Supports.** Sign panel materials and supports purchased after October 1, 2000 shall be approved by the Federal Highway Administration and MDOT as meeting NCHRP-350 crashworthy requirements. All sign panel materials and supports in use as of October 1, 2004, must be approved by FHWA and MDOTas meeting NCHRP-350 crashworthy requirements.

B. **Reflective Sheeting.** Prismatic grade reflective sheeting shall meet the requirements for ASTM D 4956 Type III prismatic sheeting or higher. All prismatic orange reflective sheeting shall be fluorescent. Engineer grade reflective sheeting shall meet the requirements for ASTM D 4956 Type I engineer grade sheeting.

C. **Legend.** Legend shall be fabricated and applied according to the *Standard Highway Signs Manual* or as detailed on the plans. The lettering and spacing on all signs shall conform to the *FHWA Standard Alphabets for Highway Signs and Pavement Markings*.

D. **Sign Covers.** All covering materials shall be exterior grade plywood, hardboard, sheet metal, aluminum, or rigid plastic; and shall be durable enough to resist deterioration due to weathering and atmospheric conditions for the duration of the project. Burlap or other flexible material shall not be allowed. The coverings shall be opaque during all light and weather conditions and shall cover the entire front of sign panels. Coverings for overhead signs and large guide signs (exceeding 3200 square feet) will not be required to cover the entire sign panel, but shall cover conflicting information.

922.03 Channelizing Devices. Channelizing devices include, but are not limited to, cones, drums, Type III barricades and temporary concrete barrier. Reflective sheeting for all channelizing devices shall meet the requirements of ASTM D 4956 Type III high intensity sheeting.

A. **Cones.** Traffic cones shall have a minimum height of 28 inches. The manufacturer shall supply certification to the purchaser that the cone meets NCHRP-350 crashworthy requirements.

B. **Drums.** Drums shall be composed of a low density polyethylene plastic. High density polyethylene plastic is not permitted. The manufacturer shall supply certification to the purchaser that the drum meets NCHRP-350 crash worthy requirements. Reflectorized sheeting used on drums shall meet the requirements of ASTM D 4956 flexible Type III high intensity and shall be 6-inch stripes. Drum striping design shall conform to Standard Plan 127-R Series.

C. **Drums with Lights.** Drums with warning lights attached must be approved by the FHWA as meeting NCHRP-350 crashworthy requirements.

D. **Type III Barricades.** Type III Barricades shall consist of three horizontal reflectorized rails, supports, warning lights, 12-foot section. Both sides of the three rails shall be reflectorized with orange and white diagonal striped ASTM Type III high intensity sheeting. Type III barricades purchased or fabricated after October 1, 2000 must be approved by FHWA and MDOT as meeting NCHRP-350 crash worthy requirements. All Type III barricades in use after October 1, 2004, must be approved by FHWA and MDOT as meeting NCHRP-350 crash-worthiness requirements.

E. **Temporary Concrete Barrier.** Temporary concrete barrier shall conform to Standard Plan R-52 Series. Barrier may be either precast sections or slip-formed on the project site. Precast sections must be selected from the Qualified Products List. The minimum length of temporary barrier sections shall be 10 feet, however, temporary concrete barrier sections 20 feet in length will be permitted, as approved by the Engineer, contingent upon the Contractor's ability to safely handle the longer and heavier units. The shorter barrier sections will be required in locations where use of longer sections would not permit the desired curvature or deflection in barrier alignment.

The barrier shall be cast with Grade S3 concrete and cured according to subsection 804.03.F. Weather and temperature limitations of subsection 602.03.T will apply. The temporary concrete barrier surface shall have a uniform smooth finish similar to one resulting from a metal finishing tool or a broom with soft bristle.

Temporary concrete barrier sections which have been structurally damaged during handling, or by traffic, will not be permitted on the project and shall be replaced by the Contractor. Nonstructural damage that affects the intended performance of the barrier shall be patched with approved concrete or mortar mix when directed by the Engineer.

End attachments shall withstand a pull-out force of 30,000 lbf. The Engineer may conduct selective tests to ensure that temporary barrier units meet this requirement. If failure occurs in the initial testing, the Engineer may conduct more extensive testing. Subsequent failure to meet the 30,000 lbf pull-out strength in other units may be cause for rejection of all temporary concrete barrier units proposed for use on the project.

Lifting devices or openings to enhance placement are optional, but lifting devices shall not protrude from the sides of the barrier while the barrier is in place.

Temporary concrete barrier installations shall be delineated with barrier markers. One Type B high intensity light shall be installed at all approaching taper/tangent breakpoints adjacent to traffic.

1. **Barrier Reflector Markers.** Barrier reflector markers shall be installed on temporary concrete barrier to delineate the barrier wall. The barrier reflector marker shall be trapezoid or rectangular with a minimum reflective area of 7.5 square inches composed of methyl acrylate. Initial photometric requirements at 0.2 degrees observation angle

and 0 degrees entrance angle must be a minimum 9 candela/lux for white markers and 6.5 candela/lux for yellow markers.

For precast concrete barrier, barrier reflector markers of appropriate color shall be installed or replaced as necessary prior to initial operation of the concrete barrier. For slip-form concrete barrier, barrier markers of appropriate color shall be installed after the concrete barrier has cured for a minimum of three days, but prior to initial operation. Barrier reflector markers which are not acceptable on the initial concrete barrier placement shall be removed and replaced at the Contractor's expense.

All dirt and curing compound shall be removed from the concrete barrier wall (spot area) prior to installing the barrier marker. The barrier marker shall be installed with the manufacturer's recommended adhesive and according to manufacturer's recommendations. The barrier marker shall be installed near the center of the barrier section at a height of 18 inches ± 1 inch from the bottom of barrier to the top of marker. Maximum longitudinal spacing shall be 20 feet. The color of the reflector markers shall match the color requirement for edgeline pavement marking.

2. **End-Attachment Retrofit for Existing Concrete Barrier Sections.** This includes concrete barrier sections which have been constructed without end-attachments and concrete barrier sections with end-attachments that need replacing because of failure to meet pull-out requirements. Two ⅝-inch diameter holes shall be drilled a minimum of 12 inches deep at each attachment location.

   After each hole is drilled clean properly to ensure adhesion of bonding material to the concrete to develop the required strength. The holes must be blown out using an oil-less air supply with an extender attached to the line that will reach to the back of the hole. Brush out the hole using a stiff wire brush which also extends to the back of the hole. Repeat these steps by blowing the hole out again, brushing again, and then blowing out one final time.

   A ½-inch, galvanized, wire centered, steel cable shall be used for all connections that are to be retrofitted. Ultimate tensile strength (breaking strength) of the ½ inch steel cable shall be a minimum of 23,000 lbf. Before the galvanized steel cable is inserted into the bonding material, remove any petroleum based residue that may have been used to protect the cable during storage.

   Each end of the galvanized steel cable shall be inserted a minimum of 12 inches into one of the ⅝-inch diameter holes to form a loop. Maintain 2¼ inches to 2⅝ inches from the end of the barrier surface to the inside edge of the cable. All loops outside of this range will be rejected. The bonding material used shall be selected from the Qualified Products List. The 30,000 lbf sustained pull-out requirement is the governing criterion for acceptability regardless of the bonding material used. A sufficient amount of bonding material shall be placed in each hole to ensure displacement of bonding material out the front of the hole (minimum of 2/3 full).

   No retrofit work will be permitted if the temperature of the concrete (not air temperature) surrounding the hole is below 35 °F.

Previously constructed temporary concrete barrier sections that were constructed using a previous standard will be accepted provided they meet the 30,000 lbf sustained pull-out requirement and they were constructed using ½-inch diameter, galvanized, wire centered, steel cable. No other end-attachment system, such as eyebolts, will be allowed.

Temporary concrete barriers which meet all the requirements except for the end-attachments, can be retrofitted by placing two additional end attachments in the manner specified. The new end attachments shall be installed between the existing cable loops (left in place). The upper end-attachment shall be 2 inches ± ½ inch below the existing upper end-attachment, and the lower end-attachment shall be 2 inches ± ½ inch above the existing lower end-attachment according to Standard Plan R-32 Series.

3. **End-Attachment For New Form-Cast Barrier Sections (Does Not Include Slip-Forming).** End-attachments for new form-cast concrete barrier sections may be constructed using one of the following three methods:

   a. A continuous cable method that involves extending a length of cable through the entire length of the barrier section. Each end of the cable is then bent into a loop and seized with two clamps at each end per Standard Plan R-32 Series.

   b. A seized cable method that involves bending a length of cable into a loop and then seizing it with three clamps. (Note: This cable has a minimum embedment of 18 inches according to Standard Plan R-32 Series. Concrete consolidation around the cable is essential to achieve the required pull-out force.)

   c. The retrofit method described in subsection 812.02.C.4.b may be used after the barrier has cured 14 days.

   A ½-inch, galvanized, wire centered, steel cable shall be used for all loop connections. Ultimate tensile strength (breaking strength) of the ½-inch steel cable shall be a minimum of 23,000 lbf.

4. **Testing the End-Attachment Assembly.** Each end-attachment assembly, whether retrofitted, continuous cable, or seized, shall meet the requirements of MTM 716. The Contractor shall be responsible for all pull-out testing and shall provide a Type D certification of testing performed.

922.04 Temporary Pavement Markings. Temporary pavement markings shall consist of painted lines, pavement marking tape, and temporary raised pavement markers (TRPMs).

A. **Pavement Marking Materials.** The paint and preformed tape shall be selected from the Qualified Products List.

   1. **Pavement Marking, Type R.** Type R markings are specified where the markings applied need to be removed during the life of the contract. Temporary pavement marking, Type R shall be preformed tape. Preformed tape shall be applied and removed according to the manufacturer's instructions.

2. **Pavement Marking, Type NR.** Type NR markings are specified where the markings applied need not be removed. Temporary pavement markings, Type NR shall be either preformed tape or paint as specified. Materials for temporary pavement marking, Type NR shall consist of either preformed tape or paint reflectorized with glass beads. The tape shall be flexible and remain conformed to the texture of the pavement surface following application.

B. **Temporary Raised Pavement Markers (TRPMs).** Temporary raised pavement markers shall be reflectorized on one or both sides depending on exposure to one-way or two-way traffic. The TRPMs shall be installed with the manufacturer's recommended adhesive and according to the manufacturer's instructions.

1. TRPM Type 1 shall consist of a flexible retroreflective strip with a protective removable plastic shield, which may be used as temporary pavement markings on a hot mix asphalt (HMA) pavement surface prior to chip seal applications.

2. TRPM Type 2 shall consist of a flexible retroreflective strip which may be used as temporary pavement markings on interim HMA lifts or concrete surfaces.

3. TRPM Type 3 shall consist of a solid plastic device with a retroreflective face surface, which may be used as durable temporary pavement markings.

922.05 Lighting Devices.

A. **Lighted Arrow, Types B and C.** Lighted arrows furnished for traffic control in work zones shall consist of a lighted arrow panel, controller, and a power supply, all mounted on a heavy-duty trailer.

1. **Lighted Arrow Panel.** The panel shall be aluminum and flat black non-reflective. Type B panels shall be a minimum 30 inches high by 60 inches wide and shall be equipped with 13 light emitting diode (LED) amber lights. Type C panels shall be a minimum 48 inches high by 96 inches wide and shall be equipped with 15 LED amber lights. The lamps shall present the following flashing message modes: left arrow, right arrow, double arrow, and caution. A minimum of three indicator lights shall be placed on the back of the panel to indicate which message mode is in operation.

2. **Controller.** A photoelectrically controlled circuit shall automatically adjust the lamp intensity to ambient light conditions and shall not have manual override. There shall be automatic intensity control that keeps the lamps at constant brightness when low battery conditions exist.

3. **Power Supply.** Power supply shall be solar with battery backup. When fully charged, the arrow panel shall be capable of operating for twenty days in single arrow mode with the photocell covered. There shall be a built-in 110 VAC battery charger.

4. **Legibility.** The arrow panel shall have an average legibility of one mile and shall be legible from ½ mile when viewed 10 degrees either side of center. When installed for field use, legibility requirements in subsection 812.03.6 must be met.

5. **Trailer.** All components of the trailer, with the exception of the sign panel, shall be Highway Orange.

B. **Warning Lights.** Warning lights shall have light emitting diode technology and meet the current Institute of Transportation Engineers *Purchase Specification for Flashing and Steady Burn Warning Lights*. Lights shall be powered by two 6-volt or four D-cell batteries and maintained in accordance with section 812.03.I.6. The following types of warning lights are permitted.

1. Type A - Low intensity flashing warning light, yellow lens, battery operated.

2. Type B - High intensity flashing warning light, yellow lens, battery operated. Type B lights shall have a visor affixed which will shield the lens from overhead sunlight.

3. Type C - Steady burn warning light, yellow lens, battery operated.

C. **Portable Changeable Message Signs.** Portable changeable message signs (PCMS) shall consist of a message board, controller, and power supply, all mounted on a heavy duty towable trailer.

1. **Message Board.** The PCMS shall be disk matrix, light emitting diode (LED), or both disk matrix and LED, with three message line capability. The sign shall measure a minimum 75 by 114 inches long. The sign shall provide a 18 inches character height with eight characters per line and a five wide-pixel by seven high-pixel matrix. Spacing between characters shall be twice the element stroke width. Disk matrix PCMS shall have fluorescent lighting at the top and bottom of each message line. LED PCMS shall be ventilated with forced air and have filtered inlets so interior temperature will stay within temperature limits of LEDs. There shall be a photocell to regulate the internal lighting system. There shall be a sighting device for proper alignment.

2. **Legibility.** The PCMS shall have an average legibility of 1000 feet when viewed head-on and when viewed 10 degrees either side of center.

3. **Controller.** The controller will be a micro-processor based unit with minimum storage capacity of 50 preprogrammed messages. The controller will contain a non-volatile memory to hold the keyboard created messages in memory during a non-power period. The controller will contain a password security feature to prevent unauthorized use. The controller will allow for a variable message display rate which allows for 0.25 second increments or one that can be correlated to 0.25 second increments. The controller will have a message display panel to show the message being displayed on the sign or being created on the keyboard. The display panel will also be capable of giving the operator all programming instructions.

4. **Electrical/Electronics.** The control cabinet shall have a lockable door and an interior light for night operations. The cabinet shall be ventilated with screen covering on the vents to prevent damage from insects. Connections to control cabinets and sign board shall be according to the National Electric Code 400-10 and 400-14. External electrical

wiring shall comply with the International Municipal Signal Association Wiring and Cable Specifications 20-1, 20-2, 20-5, and 20-6. All sign electronics shall be shock-mounted to reduce the effects of vibration. The shock mounting shall be provided in the circuit designs, mechanical supports for drive transistors, and in the type of conformal coating used. The printed circuit boards will also be mounted with spring-load tension screws for ease of access and removal.

5. **Power Supply.** Power supply to the sign shall be a battery with generator backup or battery with solar backup. The generator shall be electric start and be capable of continuous operation without refueling for 72 hours. Solar PCMS must be capable of sequencing a message for 18-21 consecutive days without sun in 16 °F weather conditions and have a built-in 115 VAC battery charger. Batteries shall be maintenance free.

6. **Trailer.** The trailer shall be highway orange and shall be delineated with a 4 by 18 inch strip (or equivalent) of reflectorized red and white vehicle conspicuity tape installed on each of the four sides. The trailer shall conform to the Michigan Vehicle Code and have a nonskid upper surface. The sign panel support shall move up and down and rotate 360 degrees, with a safety bolt to prevent the sign panel from lowering once in the raised position. The bottom of the sign panel shall be a minimum of 7 feet above the roadway when it is in operating mode. The hydraulic system shall include a manual pump with manual release for use as a back up for the electric hydraulic pump.

922.06 Temporary Traffic Signals and Street Lighting. Used materials and equipment will be allowed for temporary traffic signals and street lighting. All used material shall be inspected and approved by the Engineer before installation, and the Contractor shall be responsible for satisfactory performance and maintenance of such material throughout the life of the project.

922.07 Traffic Regulator Equipment.

1. **Stop/Slow Sign Paddle.** All traffic regulators shall be equipped with a stop/slow paddle that meets design specifications in the MMUTCD. Orange flags are not permitted except in case of emergencies.

2. **Traffic Regulator's Vest.** The vest, shirt, or jacket shall be a fluorescent color and shall be clearly visible at a minimum distance of 1000 feet, day and night. The retroreflective material shall be orange, yellow, white, silver, strong yellow green, or a fluorescent version of these colors and shall be designed to be visible through the full range of body motions.

3. **Traffic Regulator Apparel.** The traffic regulator shall wear head, eye, and foot protection as prescribed in the provisions of Construction Safety Standard Part 6 Personal Protective Equipment, being R408.40601 et seq, of the Michigan Administrative Code. This publication is available at no cost from the Michigan Department of Consumer and Industry Services, Standards Division, 7150 Harris Drive, Box 30643, Lansing, Michigan, 48909.

4. **Two-Way Radio System.** The two-way radio system shall have sufficient power to send and receive signals over the length of the intended flagging operations. When a two-way radio system is required, a backup system shall be held on standby readily available to the flaggers.

922.08 Miscellaneous.

A. **Dust Palliative.** Dust palliative shall be calcium chloride solids or liquid conforming to ASTM D 98, except as modified herein.

Calcium chloride solids shall have a minimum concentration of 77 percent $CaCl_2$, and may be of any gradation, provided all particles will pass a ⅜ inch sieve, and that 0-5 percent pass No. 30 sieve. Calcium chloride liquid shall be furnished in solution in concentrations of 33, 35, or 38 percent $CaCl_2$.

The Contractor shall furnish, at the time of delivery, two copies of the delivery report, which shall contain the following information.

1. The volume in gallons or weight of solution delivered, or the weight of solids delivered.

2. The concentration of solids or solution delivered, expressed as the percent of $CaCl_2$.

3. Equivalent tons of calcium chloride, $CaCl_2$. The equivalent weight of calcium chloride for the concentration shown on the delivery report shall be determined according to Table 922-1.

Table 922-1 Equivalent Weight of Calcium Chloride.

Concentration	Pounds of Calcium Chloride	
	Per Gallon of Solution	Per Pound of Solution or Solids
33 Percent	3.7	0.33
35 Percent	3.9	0.35
38 Percent	4.4	0.38
77 Percent	N/A	0.77

4. Copy of manufacturer's certification that the calcium chloride conforms to these specifications. If manufacturer's certification indicates a solution does not conform to the concentration stated on the delivery report, the equivalent weight of calcium chloride will be that indicated in Table 922-1 for the next lower concentration to which the solution does conform. If manufacturer's certification indicates a solution has a concentration less than that required for a 33 percent concentration, or a quantity of solids has a concentration less than that required for 77 percent concentration, the weight of equivalent calcium chloride will be based on the determined concentration. If manufacturer's certification indicates a concentration of calcium chloride greater than that stated on the delivery report, the weight of equivalent calcium chloride will still be computed for the concentration indicated on the delivery report.